(b) A motor provides a constant torque of M = 150 Nm to a hoisting pulley of mass 25 kg and mass moment of Inertia 0·9 kg m². The pulley lifts 200 N block starting from rest. Determine speed of block after it rises by 2 m. Fig. 12.

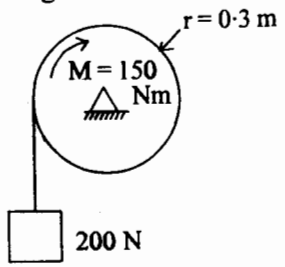

Fig. 12

7. Answer any **two** parts of the following :— **(2×5=10)**

(a) Determine the elongation of a uniform bar hanging under its own weight.

(b) A compound bar made of steel and CI shown in Fig. 13 has a gap of 1 mm. If E_s = 200 GPa and E_{CI} = 105 GPa, find the stresses in the bars.

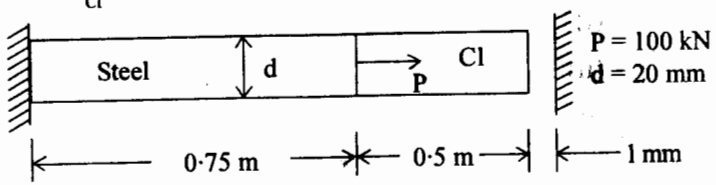

Fig. 13

(c) A shaft of hollow circular section has outer diameter 120 mm, Inner diameter 100 mm. Permissible shear stress is 95 MPa. Angle of twist is not to exceed 3·6° in a length of 3 m. The maximum value of torque may exceeds the mean by 30%. Speed of shaft is 2 rps. Determine the maximum value of Power that can be transmitted.

Modulus of regidity = 80 GPa.

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4303 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. II) THEORY EXAMINATION 2011-12

ENGINEERING MECHANICS

Time : 3 Hours *Total Marks : 100*

Note :— (1) This question paper is in **three** sections. Section—A carries **20** marks. Section B carries **30** marks and Section—C carries **50** marks.

(2) Attempt **all questions**. Marks are indicated against each question.

(3) Assume missing data suitably if any.

SECTION—A

1. Answer **all** the following parts :— **(10×2=20)**

(a) Define the principle of transmissibility of forces.

(b) Describe the equilibrium of a body if it is acted upon by only three forces.

(c) List the assumptions made in the analysis of a Truss.

(d) What is the relationship between load, shear force and bending moment ?

(e) Product of inertia of an area about an axis is zero. Explain.

(f) What is the moment of Inertia of a square plate of side 'a' about its diagonal ?

(g) Define Engineering stress and True stress.

(h) D'Alembert's principle is basically otherwise explanation of Newton's second law of motion. Comment.

(i) At what location the induced shear stress will be maximum if a circular shaft is exposed to a torque and why ?

(j) Define resilience and Proof resilience.

SECTION—B

2. Answer any **three** parts of the following :— **(3×10=30)**

(a) Fig. 1 shows a wedge B held between the block A and the surface C. A horizontal push of 10 kN is acting on the block 'A'. Find the vertical force 'P' on the wedge B so as to just move it downward. Assume coefficient of friction as 0·3 for all the surfaces of contact.

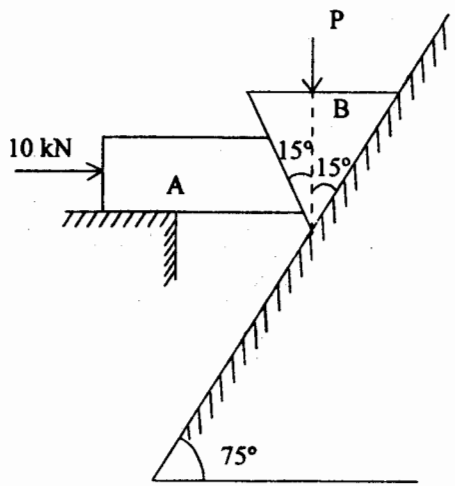

Fig. 1

(b) Derive shear force and bending moment equations and draw the SFD and BMD for the beam shown in Fig. 2. Find out the position and magnitude of maximum bending moment.

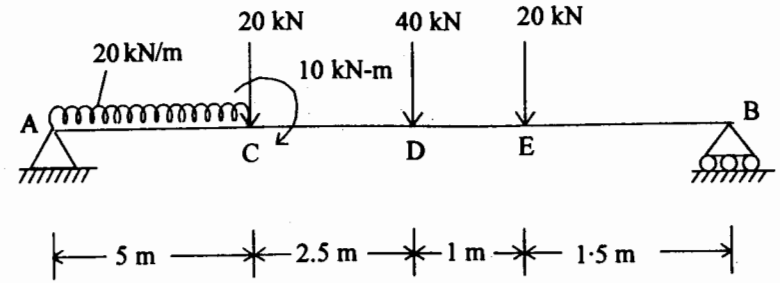

Fig. 2

(c) Determine mass moment of inertia of a solid cylinder of radius R and height h about its centroidal axis.

(d) A cylinder weighing 500 N is welded to a 1 m long uniform bar of 200 N as shown in Fig. 3. Determine the acceleration with which the assembly will rotate about point 'A', if released from rest in horizontal position. Determine the reaction at 'A' at this instant.

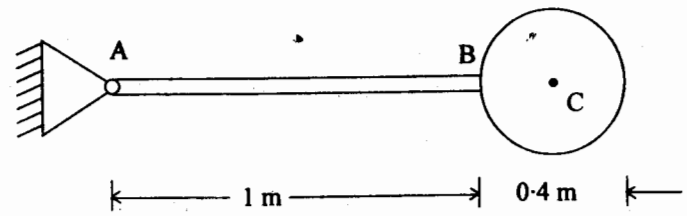

Fig. 3

(e) The cross section of a 4 m simply supported beam is shown in Fig. 4. Determine the central concentrated load, which will cause a tensile stress of 15 MPa. Also determine corresponding compressive stress.

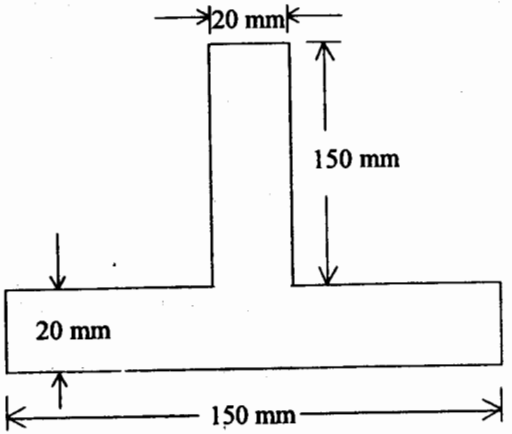

Fig. 4

SECTION—C

3. Attempt any **two** parts of the following :— **(2×5=10)**

(a) A uniform bar AB of length L and weight W lies in a vertical plane with its ends resting on two smooth surfaces on OA and OB, find angle 'θ' for equilibrium of bar. Refer Fig. 5

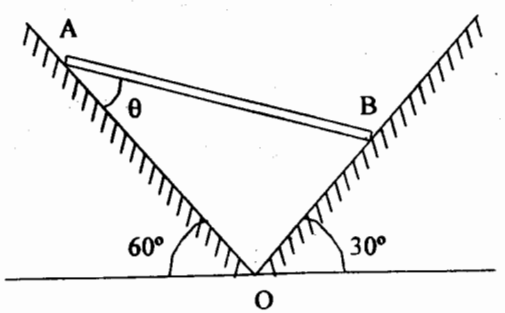

Fig. 5

(b) A 4 kN block is placed on an inclined plane as shown in Fig. 6. Find maximum value of W equilibrium if tipping does not occur. Take $\mu = 0{\cdot}25$.

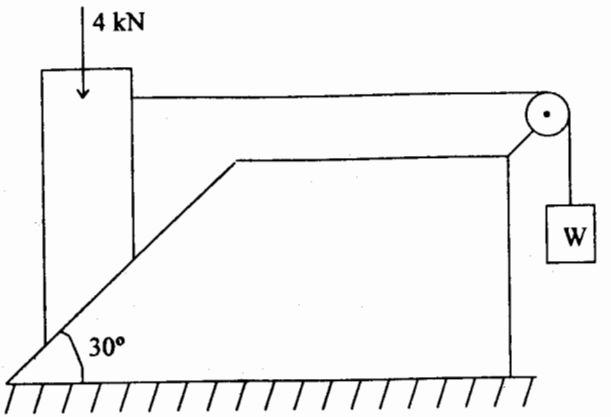

Fig. 6

(c) State and prove Varignon's theorem.

4. Answer any **one** part of the following :— **(10)**

(a) A truss is loaded as shown in Fig. 7. Find the reactions and forces in each members.

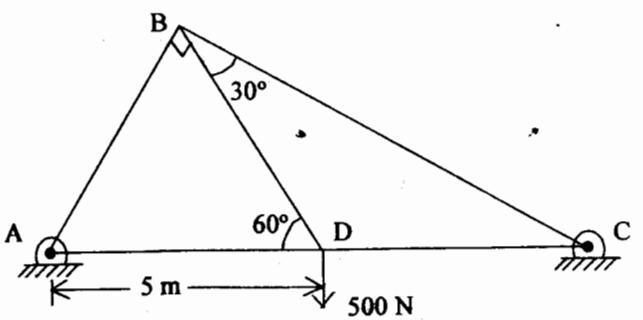

Fig. 7

(b) Draw SFD and BMD for the following loaded beam (Fig. 8) and also locate point of contraflexure.

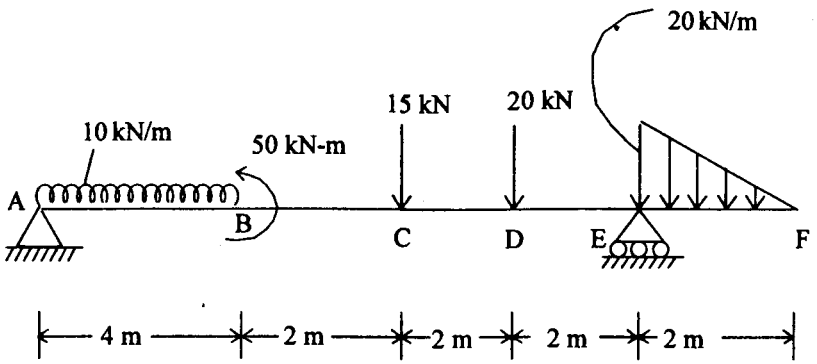

Fig. 8

5. Answer any **two** parts of the following :— **(2×5=10)**

(a) Determine length of wire such that centroid is located at point 'O'. Find the length in terms of 'r' Fig. 9.

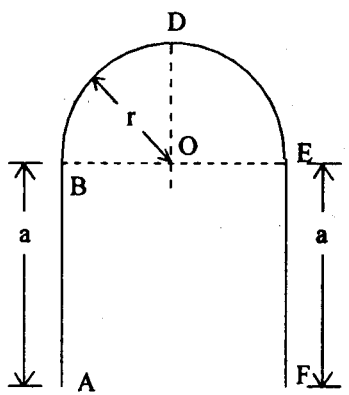

Fig. 9

(b) Explain the product of Inertia and principal moment of Inertia.

(c) Determine the moment of Inertia of the shaded area with respect to x and y axis. Fig. 10

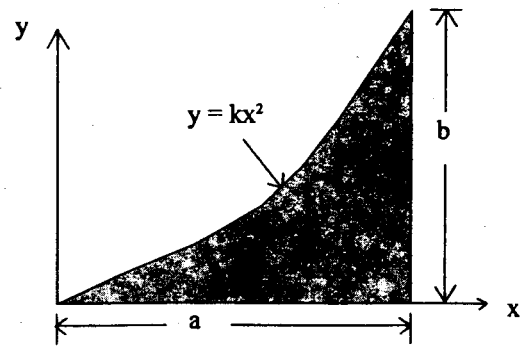

Fig. 10

6. Answer any **one** part of the following :— **(10)**

(a) The angular acceleration of a circular plate of radius 0·5 m shown in Fig. 11 is defined by $\alpha = \alpha_0 e^{-t}$. At t = 0, the plate is at rest and $\alpha_0 = 10$ rad/s². Determine magnitude of total acceleration of point 'B' when

(i) t = 0

(ii) t = 0·5 sec

(iii) t = ∞.

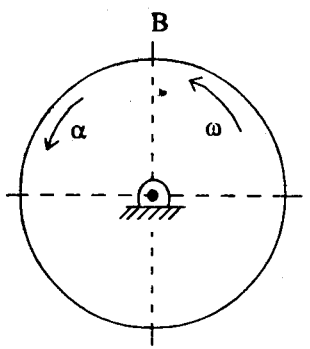

Fig. 11